Improving Jet Resolutions

Motivation

Physics Effects

Definitions of Resolution

Optimum Use of All
Detector Information

Testing New Algorithms
With Collider Data

Motivation

- Improve mass resolution for Higgs and New Physics searches (and Top?)
- Sharpen Jet and Missing Et cuts to improve signal/background ratios (most relevant for Top?)
- Use the extended tracking of the Run II detectors
- Reduce pileup effects by selecting tracks only from the primary collision vertex
- Do the best we can...

Physics Effects

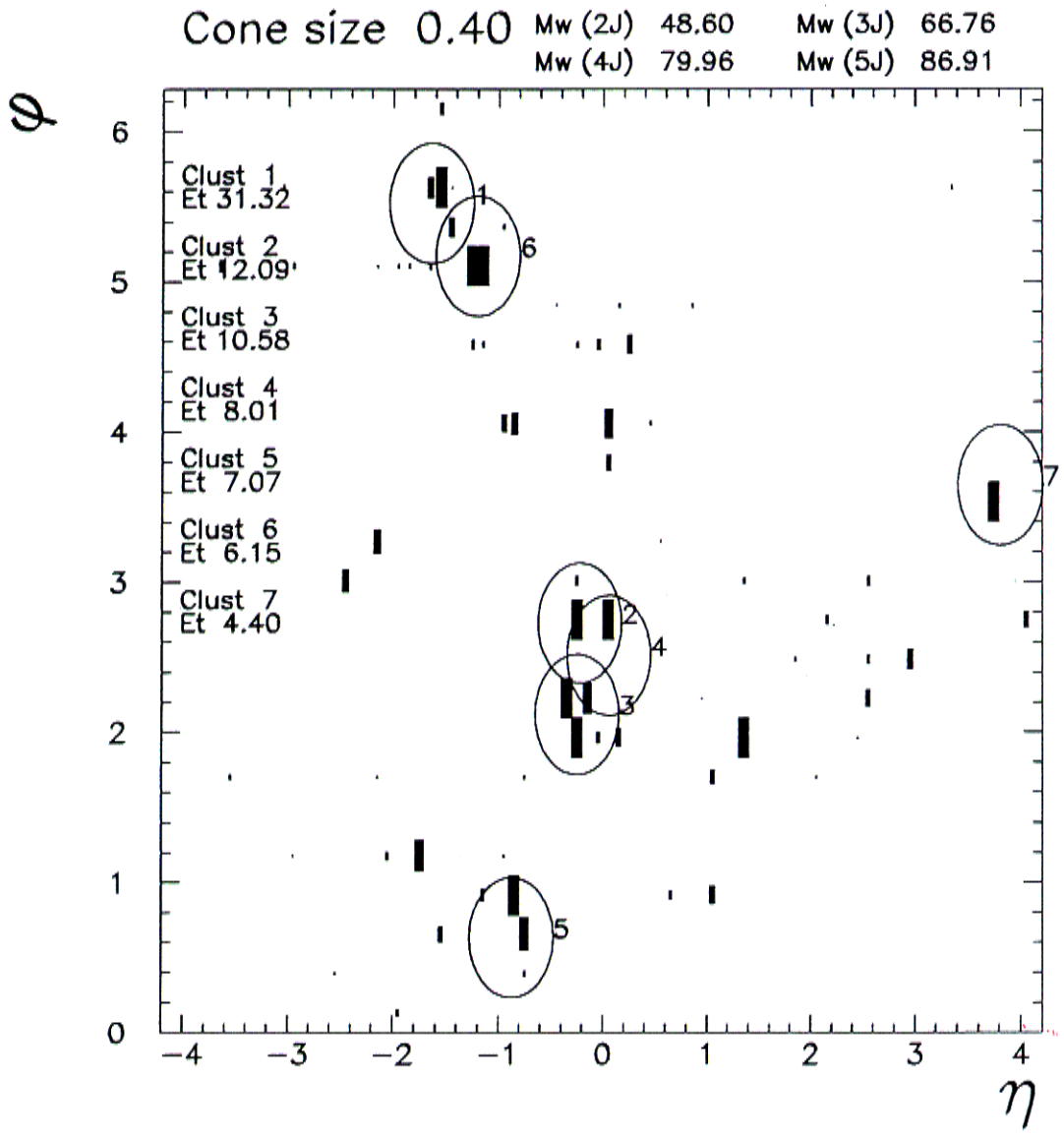
Large-Angle Final State Gluon Radiation

Initial State Gluon Radiation

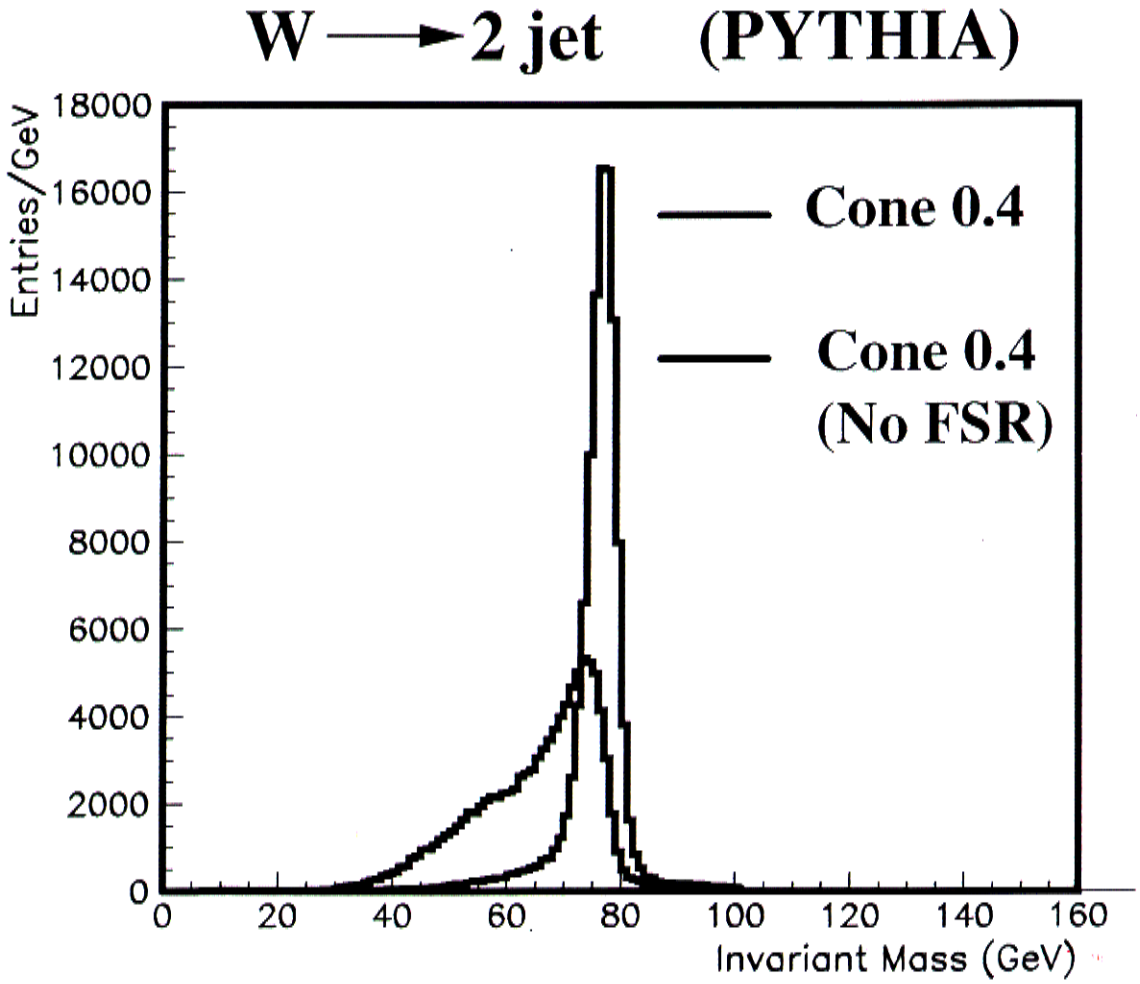
Underlying Event Fluctuations

Neutrinos from Heavy Quark Decays

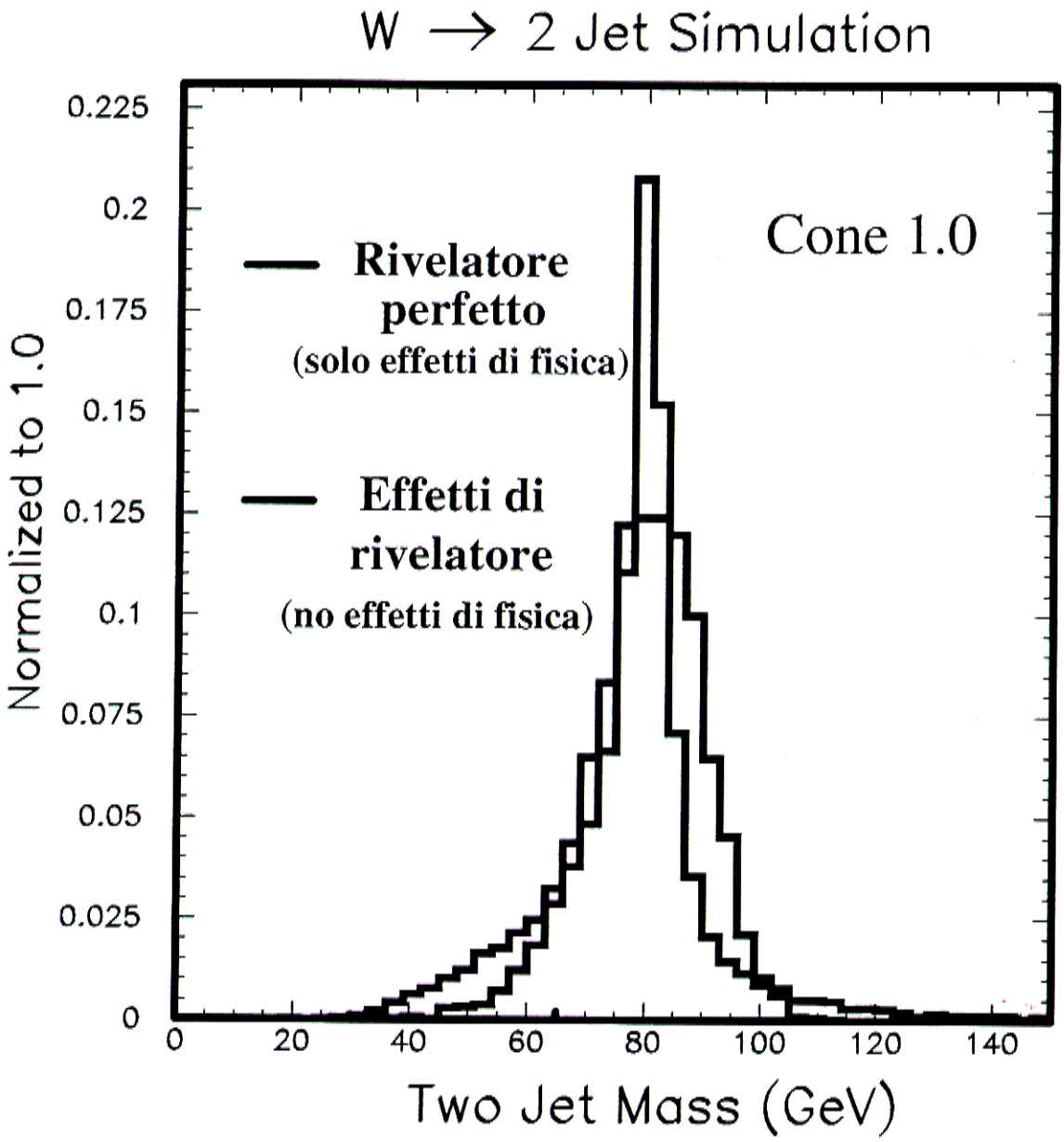
W Event as an Example of Gluon Radiation Effects



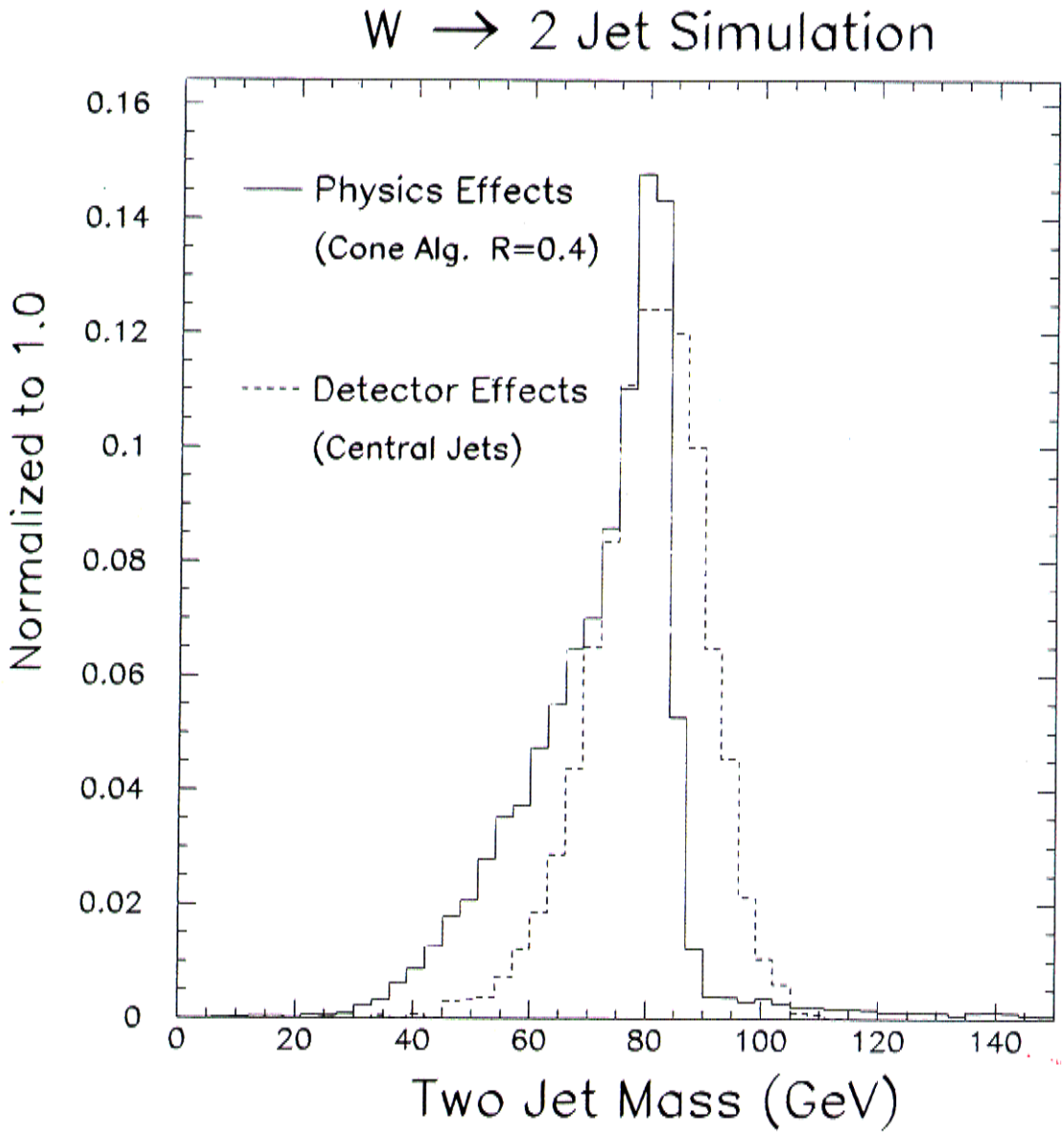
Main Physics Effect is Due to Final State Gluon Radiation



Comparison of Pure Physics Effects and Pure Detector Effects



Same But With Cone 0.4



Strategies to Handle Gluon Radiation (other than extra jet cuts)

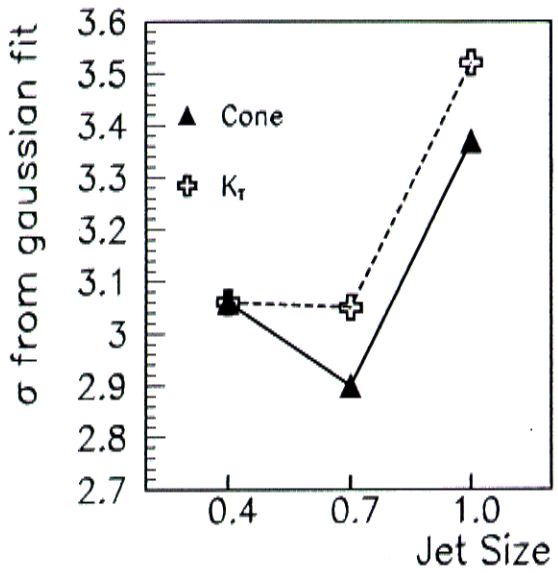
Optimized Cone Size

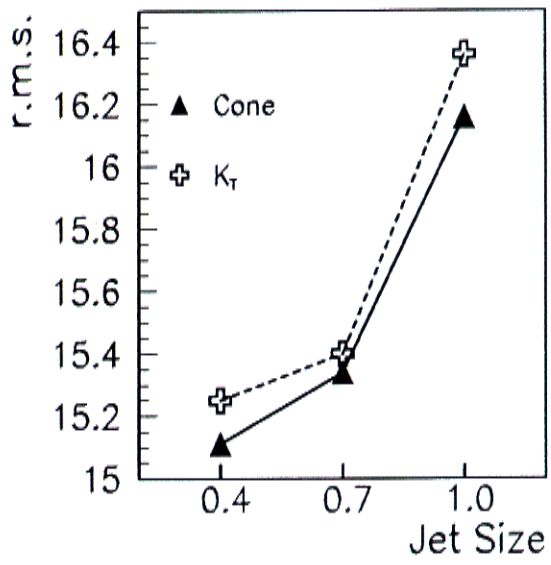
Kt vs Cone Algorithm

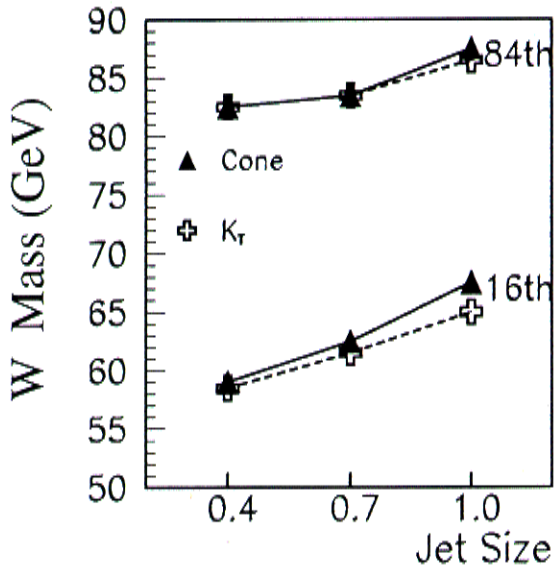
Optimized Merging Criteria of Cone Jets

Not Even Easy to Define the Best Answer

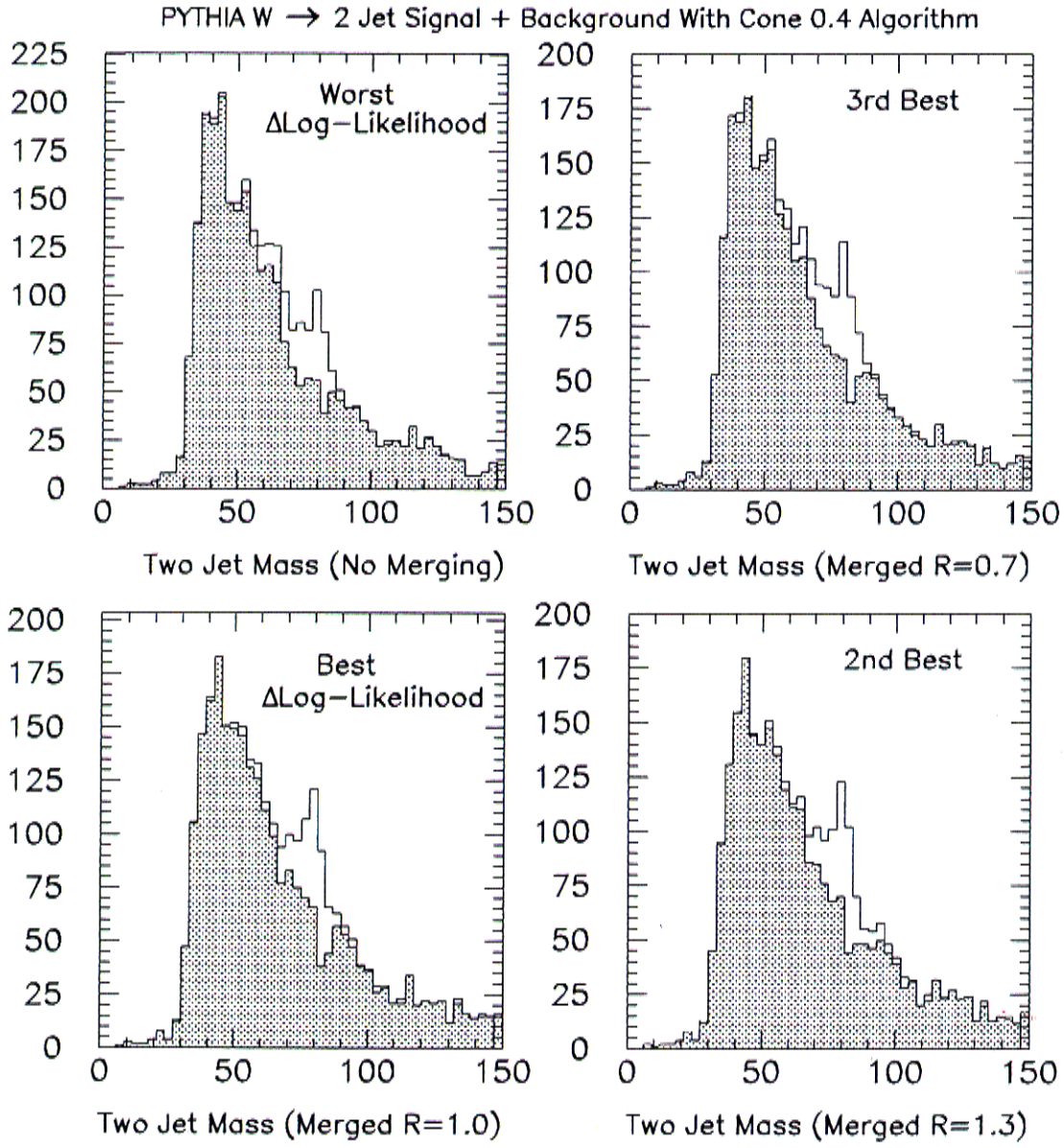
Definitions of Resolution







Full Signal to Background Study Says Merging Within Radius 1.0 Best



Implications for Top

Radius 1.0 obviously too large for Top, as separation of signal and background suffers.

Perhaps a more sophisticated merging criteria, such as cutting on the ratio of jet pt, could be applied first.

(has a detailed study been done?)

Optimum Use of Detector Information

Run I jets measured with calorimeters only

Average track pt in a 50 GeV jet is 4 GeV (eg. from a 115 GeV Higgs)

Tracking resolution for 4 GeV track is about 0.5%, while calorimeter resolution is 20-30%.

Optimum Use of Detector Information

Using tracks allows the possibility of reducing jet pileup from other collisions by (naively) x3

Preshower detectors used in ZEUS give 17% improvement
(talk by Magill at CALOR2000)

Shower Maximum detectors useful in tagging photons in jet

Optimum Use of Detector Information

Many other possibilities:

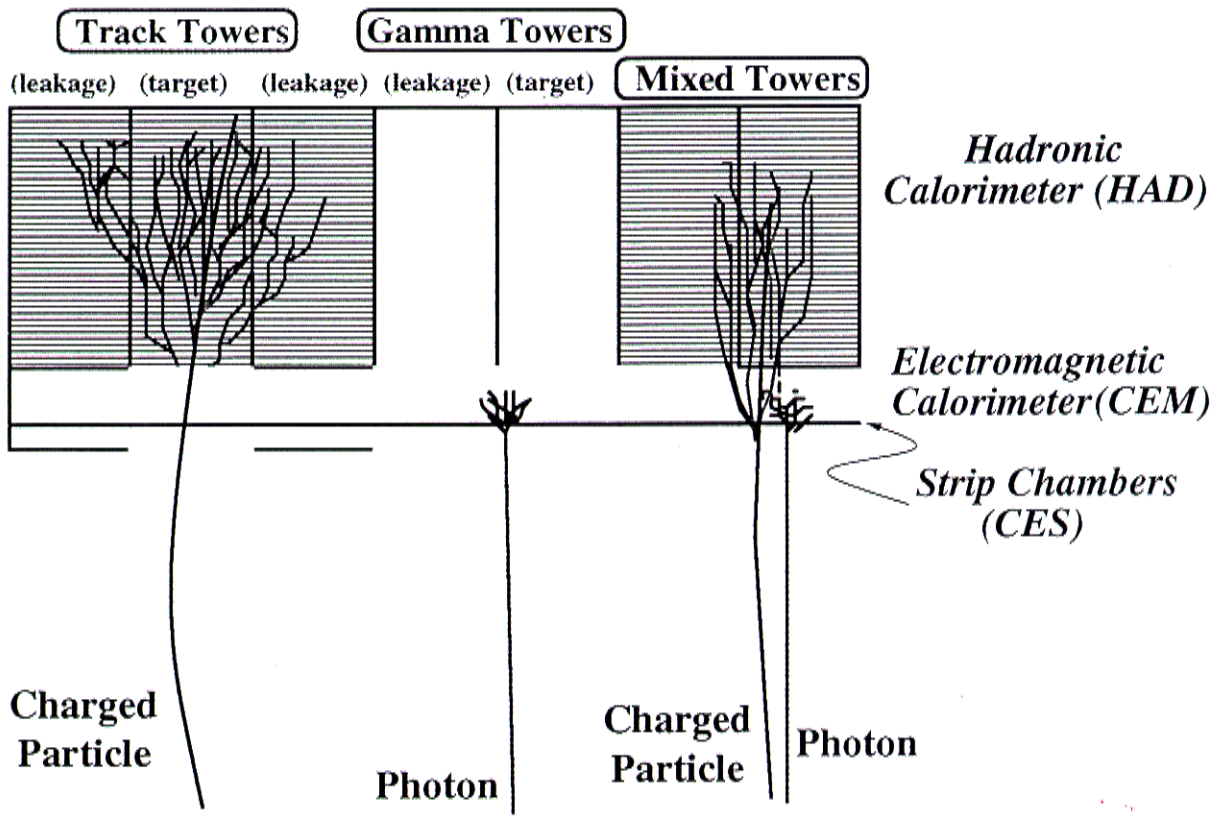
muon hits for leakage estimate

soft lepton and vertex information for b jets

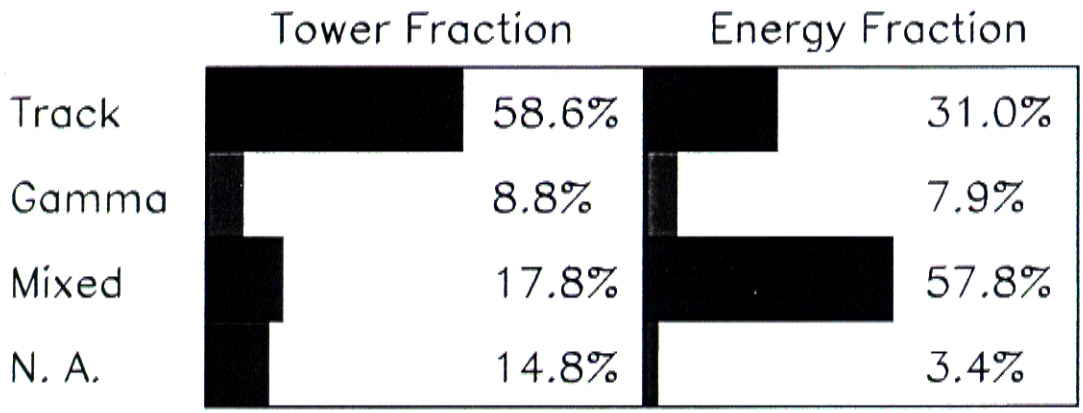
phototube ratios

...

New CDF Algorithm Using Tracking, Calorimeter, and Shower Maximum Detectors



Breakdown of Tower Types For 25-50 GeV Jets



How to Test New Algorithms on Run I/II Data?

No Perfect Way to Do This

$W \to q\bar{q}$ in Top Events
(9 Double-Tagged Events in Run I)

Present $Z \to b\bar{b}$ Signal
(Very biased Sample)

$Z \to b\bar{b}$ Signal in Run II With Silicon Trigger (Fine if it Works)

How to Test New Algorithms on Run I/II Data?

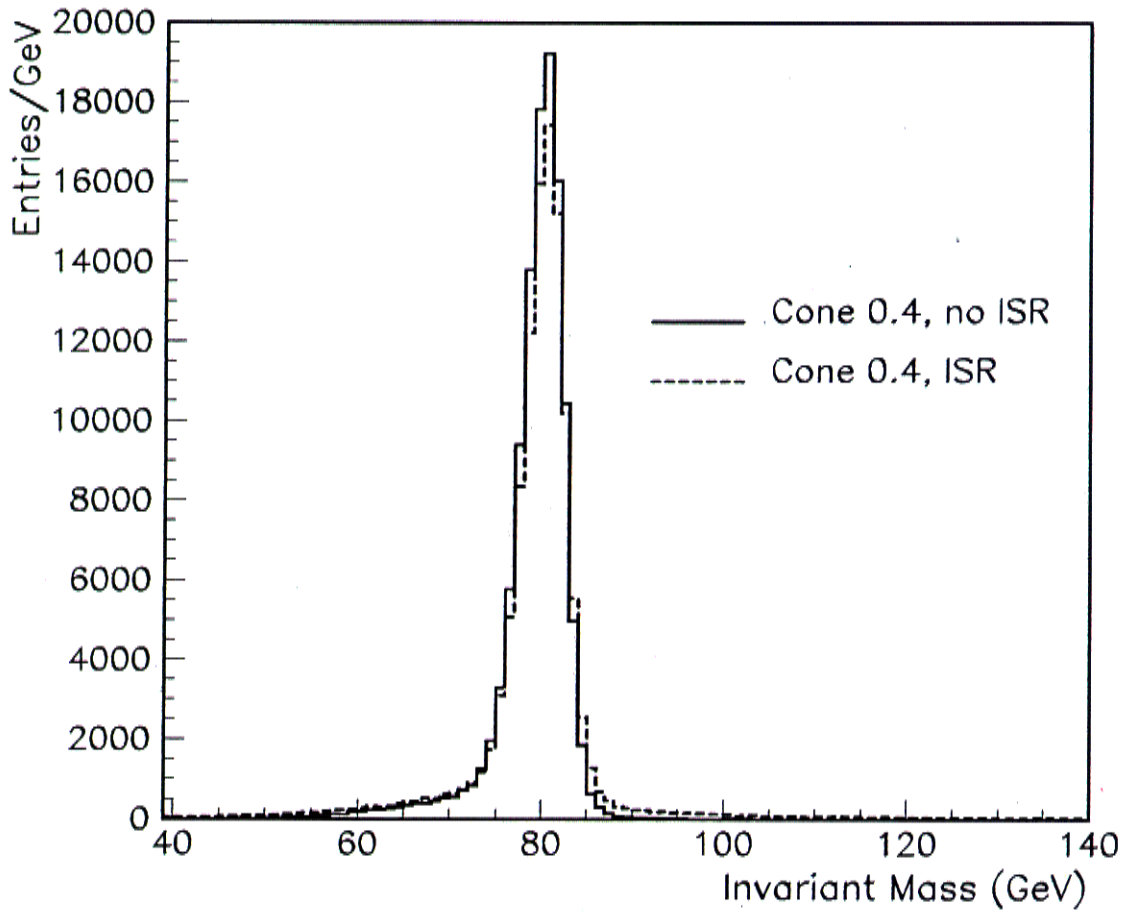
Other Methods Involve Pt Balancing of Two Back-to-Back Objects

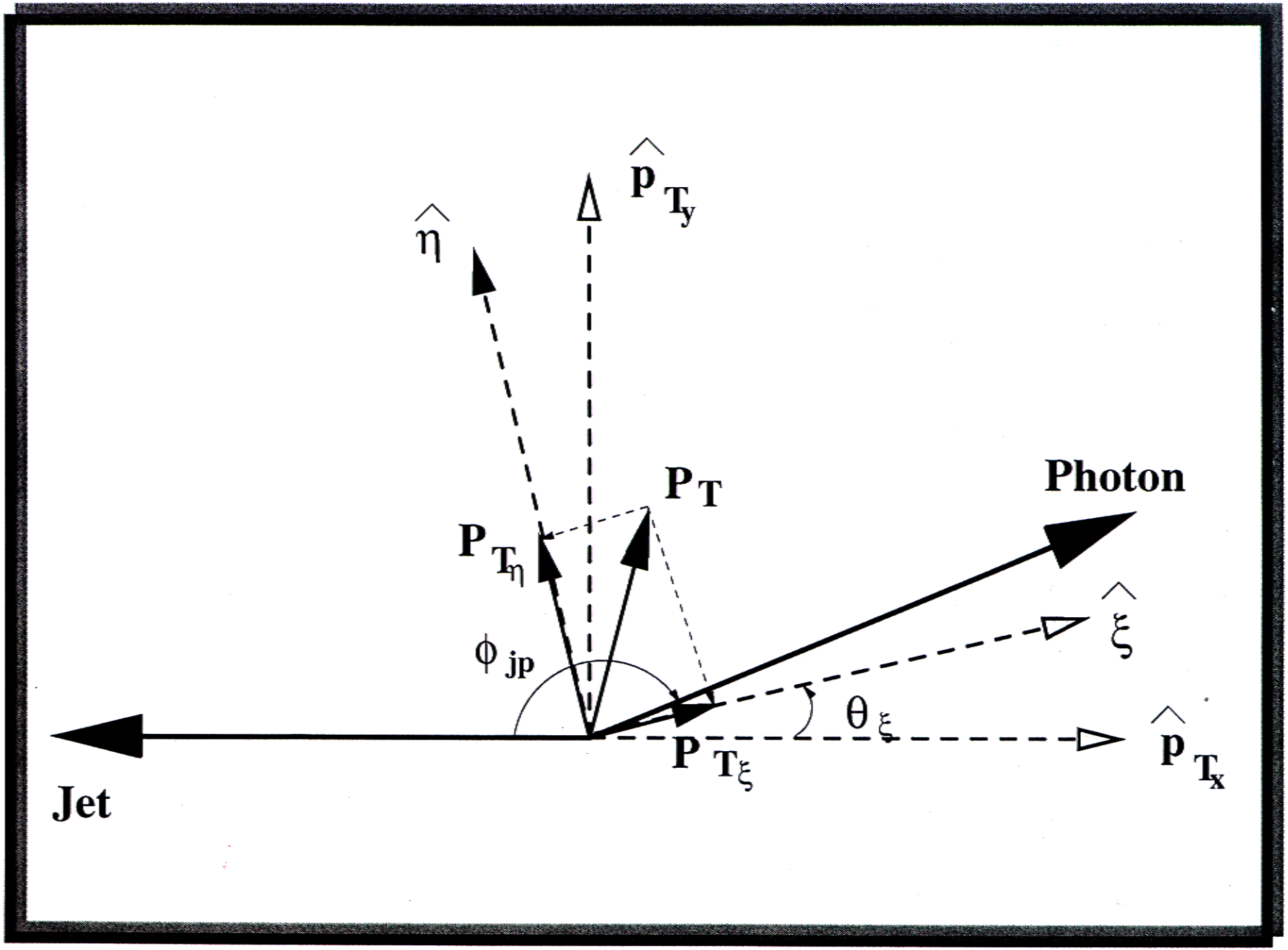
QCD Production of Dijets Best For Jets Above 150 GeV, But Main Interest is In Lower Pt Jets

For Now Use QCD Production of Direct Photon + Jet Events

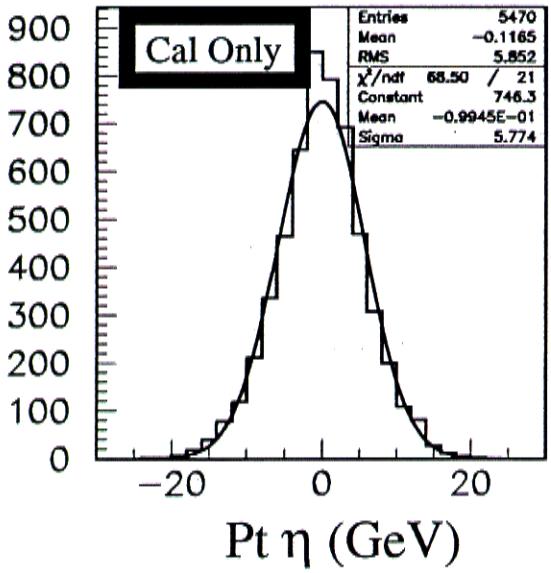
Initial State Radiation is a Significant Problem in Any Pt Balancing Method

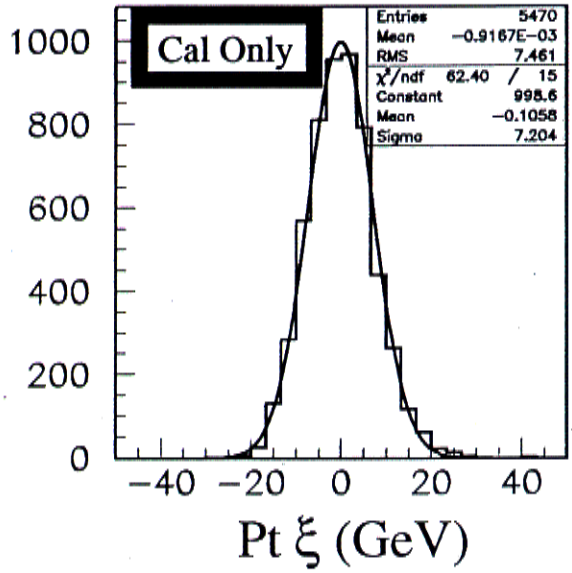
ISR Has a Significant Impact on Pt Balancing Test, But is Not Important For Dijet Mass

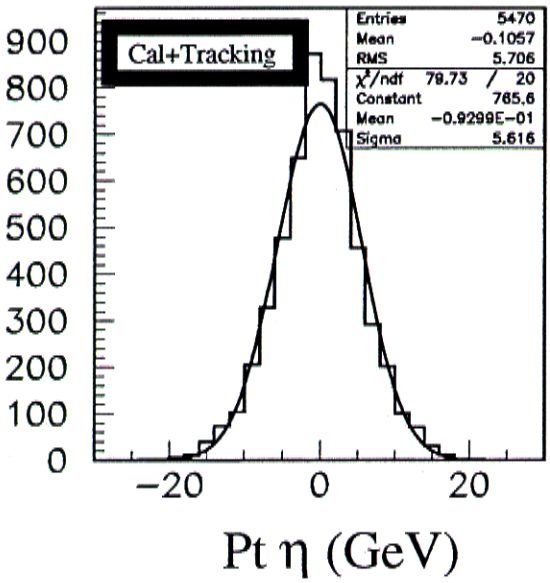


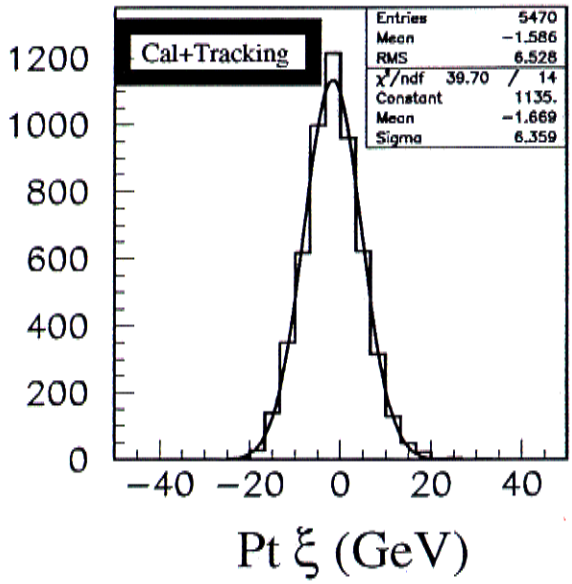

$\hat{p}_{T_y}$
$\hat{\eta}$
P_T
Photon
P_{T_η}
$\hat{\xi}$
ϕ_{jp}
θ_ξ
P_{T_ξ}
$\hat{p}_{T_x}$
Jet

Photon+Jet Events (25-30 GeV)









Conclusions

Potential Exists to Improve Jet Resolutions Beyond the Run I Top Analyses

Could Impact the Top Mass Resolution, Signal/Background Ratio, and Reduce the Luminosity Dependence Due to Multiple Vertices